

IPM Presentation

1

Mojtaba Mohammadi Najafabadi

92nd ISOLDE Collaboration Committee meeting

Friday Nov 5, 2021



INTRODUCTION TO IPM

- Institute for Research in Fundamental Sciences (IPM) is a research institute affiliated to the Ministry of Science and Technology.
- It has been founded in 1989 with the goal of performing original research in Fundamental Sciences.

Currently, the institute consists of 9 schools:

- Astronomy
- Biological Sciences
- Cognitive Sciences
- Computer Sciences
- Mathematics
- Nano Sciences
- Particles and Accelerators**
- Philosophy
- Physics

IPM is in charge of the following national projects:

-Iranian National Observatory



-Iranian Light Source Facility (ILSF)



-Collaboration with CERN (CMS experiment, CLIC, FCC, AWAKE)

- IPM Linac, designed fabricated in IPM (4 MeV Electron beam).

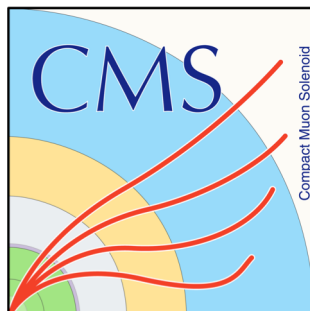


The general IPM activities are listed below:

- IPM conducts research in the line of its school research areas independently and in collaboration with other research institutes/universities inside the country and abroad.
- The institute tries to play a pioneering role in initiating and developing new subjects in the **fundamental sciences** in Iran.
- It carries out conferences as well as joint research projects, and exchanges researchers to establish links with other research institutes and universities inside and outside of Iran.
- IPM tries to provide an atmosphere to attract Iranian researches and scientists from other countries.
- It seeks to recognize the basic needs of the country in the fundamental sciences.
- IPM provides facilities and financial supports for its researchers and the researchers from other institutes and universities.



COLLABORATION WITH CMS EXPERIMENT



COLLABORATION WITH CMS EXPERIMENT

IPM joined the CERN CMS Collaboration since 2001.

The collaboration started with sending three PhD students to CERN working for the CMS and construction of the support tables and the cylindrical shielding of the Forward Hadronic Calorimeters.



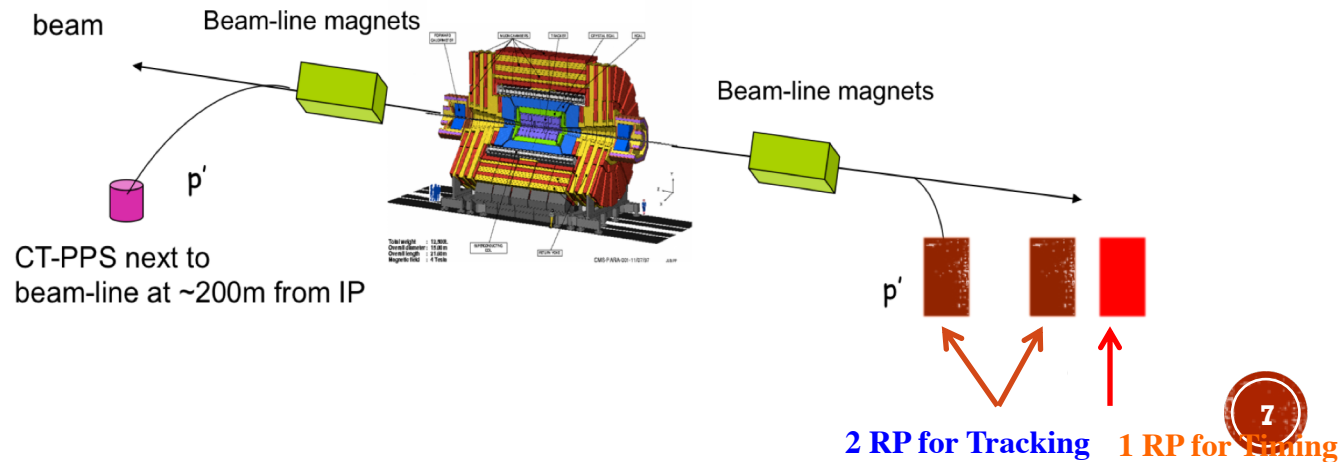
-We have around 20 physicists and engineers involved in the CMS experiment.

- In the physics analysis, IPM has been involved in:

Top quark, SUSY, Forward Physics, Exotics, Higgs boson.

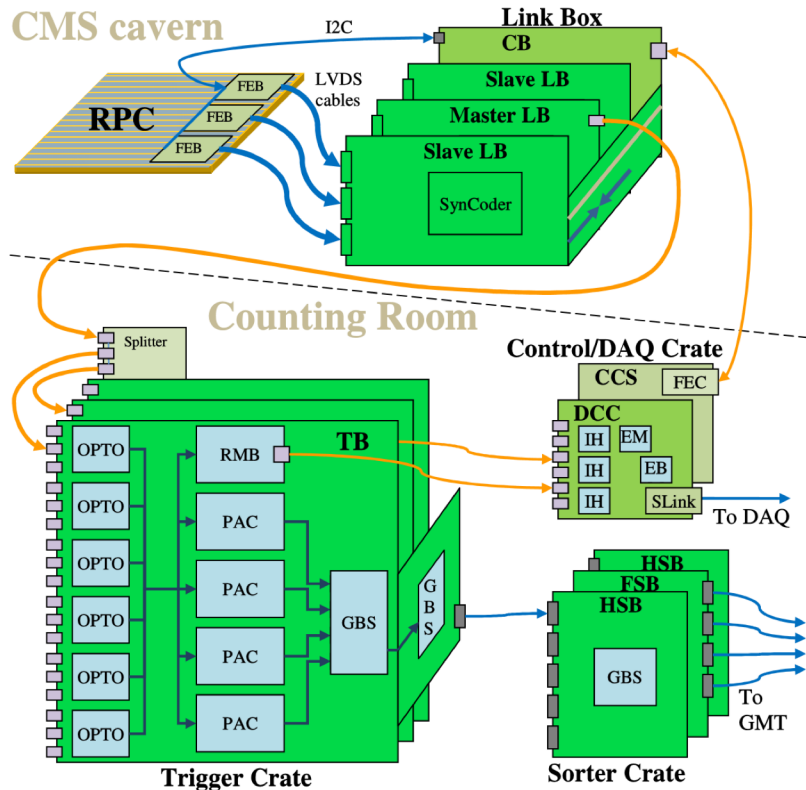
IPM group has been involved in several tasks in simulation. One the recent is related to the Proton Precision Spectrometer (PPS) detectors:

- Beam test
- Implementation of the full description of geometrical parts Geant4 simulation
- Electronic response and digitization
- Reconstruction

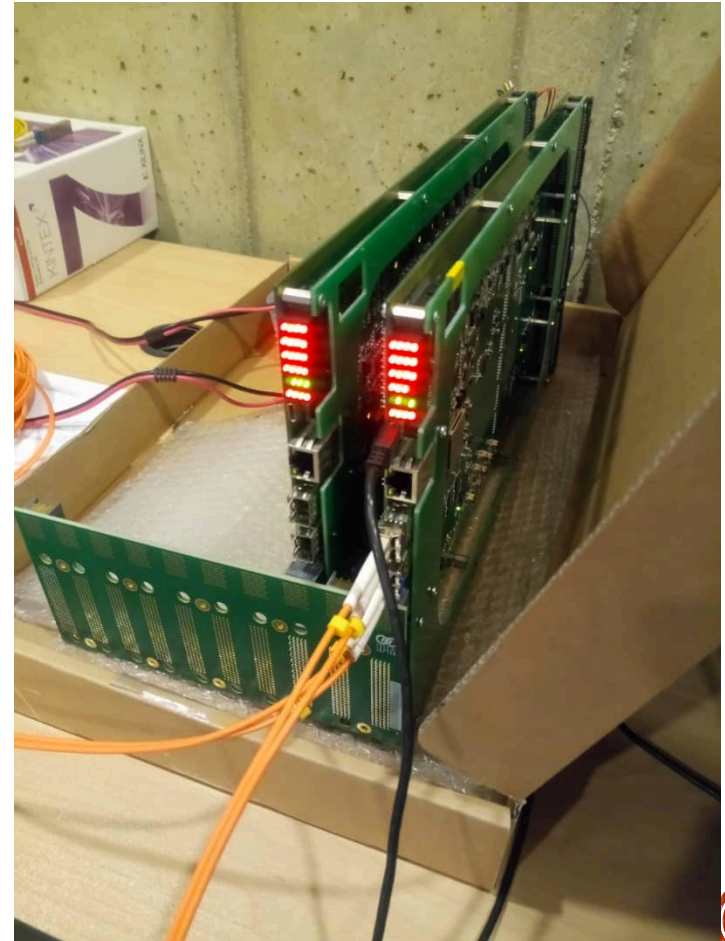


COLLABORATION WITH CMS EXPERIMENT

IPM is involved in the CMS Phase II upgrade by construction of the RPC Link boards (LB). The RPC LBs perform the data transmission, control and calibration of the RPC readout system.



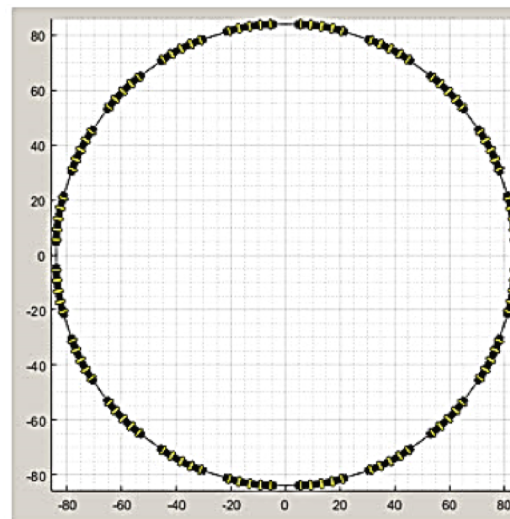
prototype

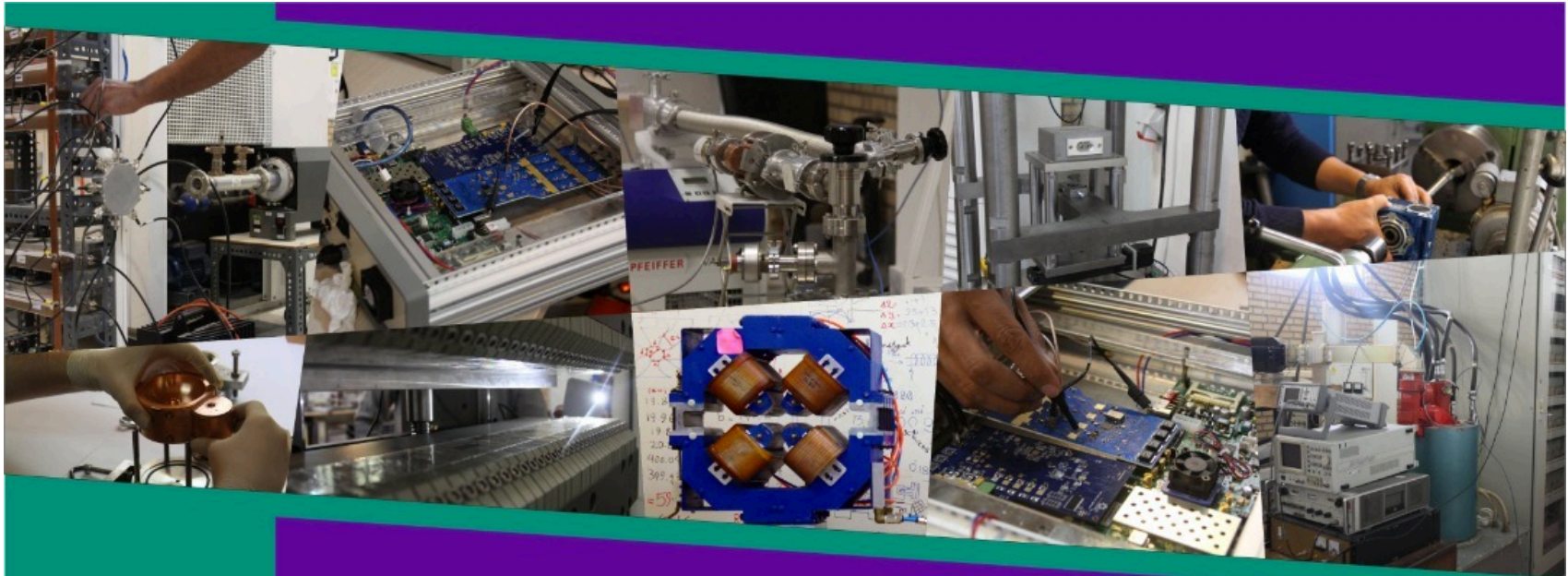




Overview

Energy	3 GeV
Circumference [m]	528
Number of <u>achromats</u>	20
Main radio frequency [MHz]	100
Harmonic number	176
Natural emittance [nm rad]	0.270
Betatron tune	44.16/16.22
Momentum compaction factor	1.82E-4
Radiation loss per turn [KeV]	406.4





RESEARCH & DEVELOPMENT

stepping into new technologies

The ILSF storage ring has been designed to be competitive in the future operation years. Some prototype accelerator components such as high-power solid-state radio frequency amplifiers, LLRF system, thermionic RF gun, storage ring H-type dipole and quadruple magnets, Hall probe system for magnetic measurement and highly stable magnet power supplies have been constructed in ILSF R&D laboratory.

- **Electromagnets & Magnetic Measurement Laboratory**
- **Girders**
- **RF systems (Solid State Amplifiers, RF Cavities)**
- **Control Systems**
- **Linac Pre-injector**
- **Beam Diagnostic Systems & Instrumentation**
- **Power Supplies (High Power, High Stability, Low Shift)**
- **Ultra High Vacuum Technology**

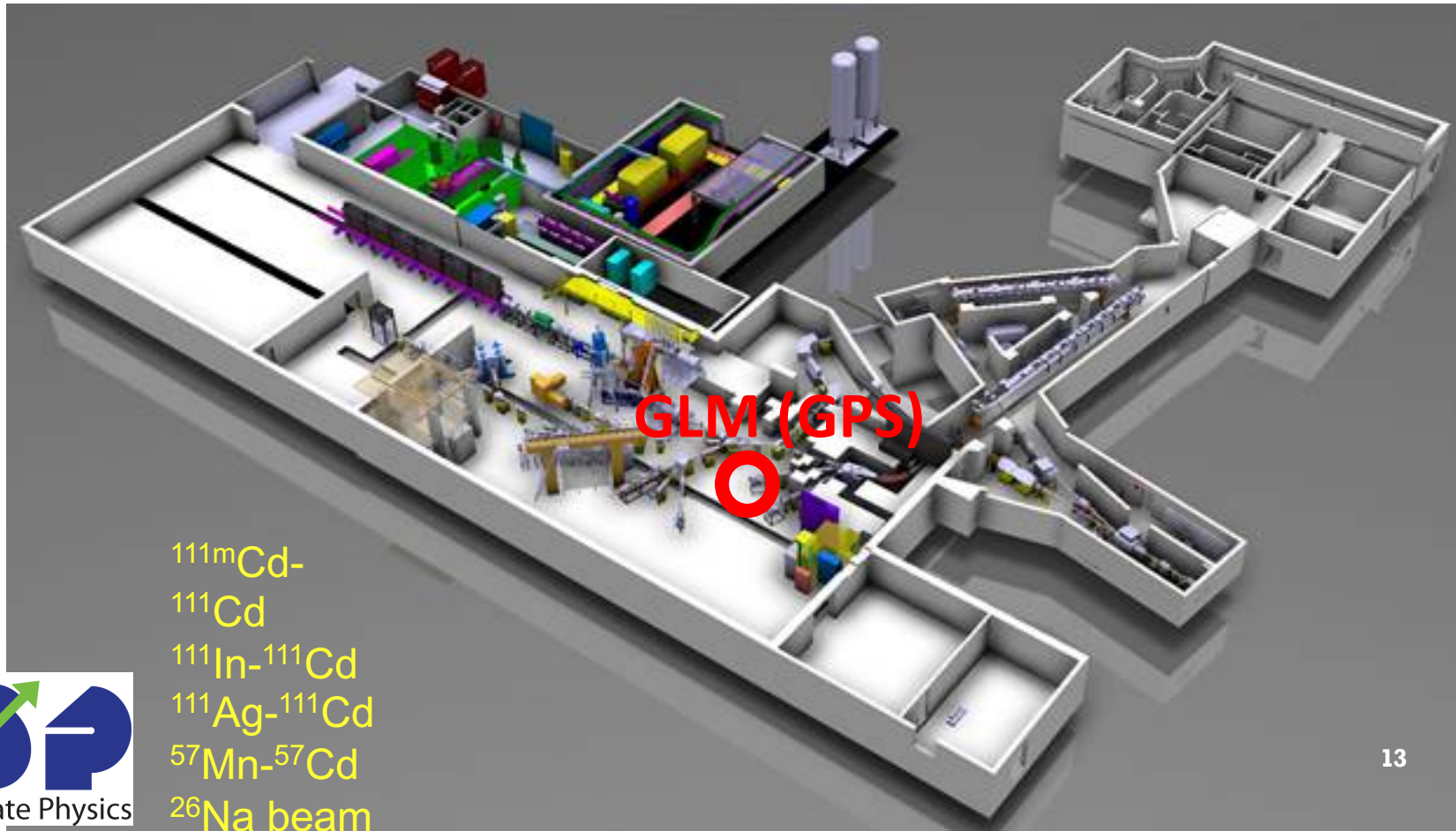
- IPM is interested to join and collaborate with ISOLDE.
- There is already a postdoctoral researcher from IPM (Adeleh Mokhles Gerami) collaborating with ISOLDE in the Solid State Physics using the GLM beamline and Mössbauer Experimental setup.
- The plan is to hire another postdoctoral researcher and involve PhD students.
- There is an interest to contribute to the HIE-ISOLDE (High Intensity Energy-ISOLDE) project in particular in hardware. More discussion and knowledge is needed to find a suitable project matched with IPM expertise.

Thanks for your attention

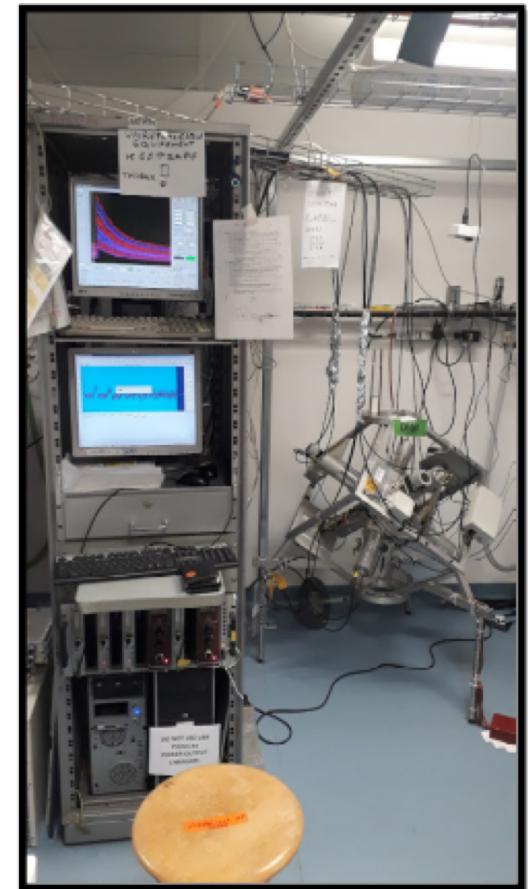
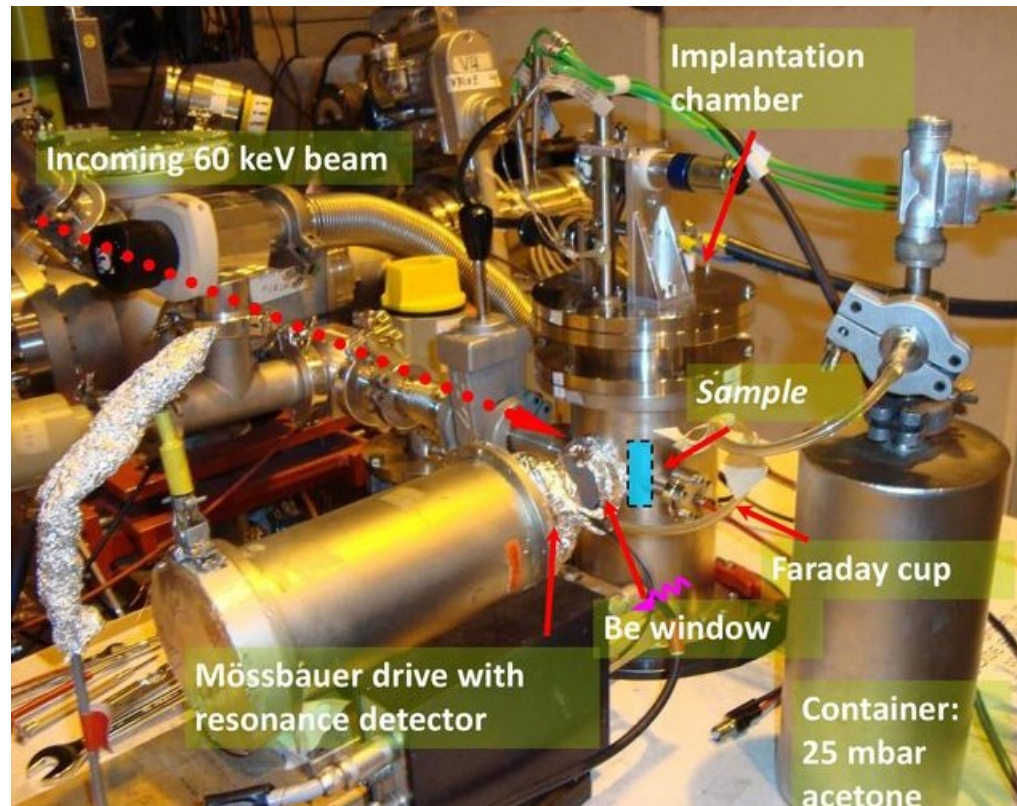
BACKUP

The setup chamber for material implantation

The GLM beamline for research in different projects including the study of novel materials, devices, and biomedical ionic liquid strategies



Mössbauer Experimental setup and Perturbed Angular Correlation (PAC)



DIGIPAC setup. Review of Scientific Instruments 82, 065105 (2011), <http://dx.doi.org/10.1063/1.3599417>

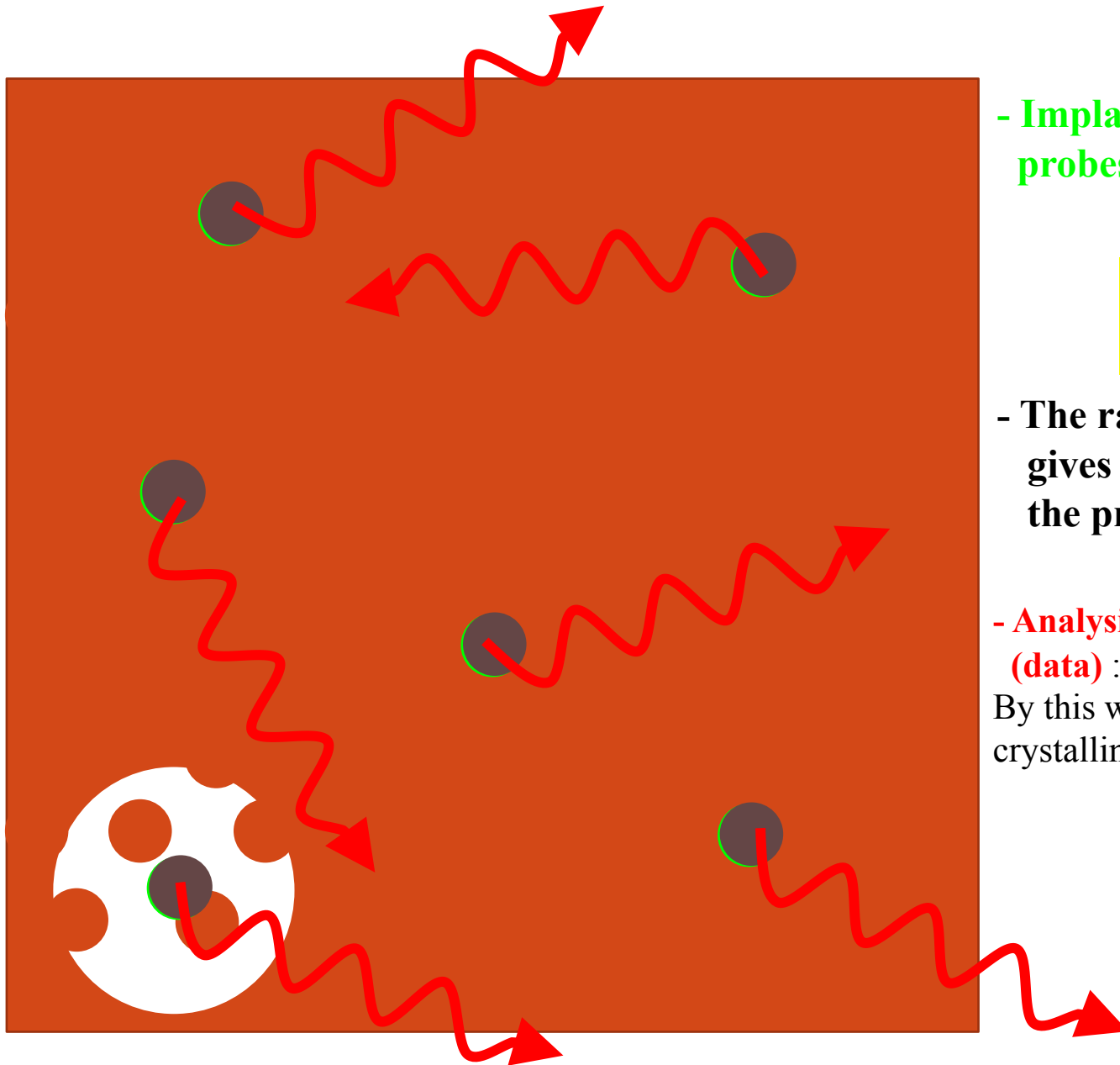
Information about materials

- **Implant Radioactive probes / impurities**



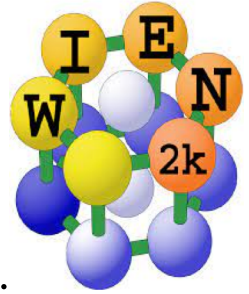
- **The radioactive decay gives information about the probe sites**

- **Analysis of Spectra (data)** : The Hyperfine parameters
By this we can study about the crystalline lattice of materials.



Calculation of hyperfine parameters using Wien2k code

The program package WIEN2k allows to perform electronic structure calculations of materials using density functional theory (DFT)



- 1. Total energies + forces on the atoms:
 - Perform structure optimization for“ real” systems
 - Investigate various magnetic structures ,exchange interactions

- 2. Electronic structure:
 - Band structure+DOS

- 3. Hyperfine parameters:
 - Isomer shifts, Asymmetry parameters ,electric field gradients

1. Group Theory Analysis to Study Phase Transitions of Quasi-2D Sr₃Hf₂O₇." Nanomaterials 11.4 (2021): 897.
2. ⁵⁷Fe Mössbauer study of epitaxial TiN thin film grown on MgO (1 0 0) by magnetron sputtering. Applied Surface Science 464 (2019)
3. 2. Atomic-scale study of the amorphous-to-crystalline phase transition mechanism in GeTe thin films. Scientific reports 7.1 (2017)
4. ⁵⁷Fe emission Mössbauer spectroscopy following dilute implantation of ⁵⁷Mn into In₂O₃." Hyperfine Interactions 237.1 (2016)